



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

April 12, 2011

Mr. David S. Lazarus
Virginia Department of Environmental Quality
P.O. Box 1105
Richmond, VA 23218

Dear Mr. Lazarus:

The United States Environmental Protection Agency (EPA) has reviewed the Virginia Department of Environmental Quality's (DEQ's) request to amend the bacteria Total Maximum Daily Load (TMDL) and waste load allocations (WLAs) developed for the tidal portion of Indian Creek, located in Northumberland and Lancaster Counties, Virginia. The original TMDL for Indian Creek (VAP-C01E-22-SF) was approved by EPA on April 8, 2009 to address primary contact (recreational) use impairments. DEQ has requested the following modifications to the original TMDL:

- The permit for the Kilmarnock Waste Water Treatment Plant (WWTP) (VA0020788) was incorrectly assigned a WLA based on the shellfish use 90th percentile water quality standard of 14 MPN/100ml. The limit imposed by DEQ within the facility's VPDES permit is the geometric mean standard of 200 MPN/100ml. DEQ will therefore revise the facility's shellfish use WLA from 2.68E+08 MPN/day to 3.82+09 MPN/day to provide consistency between the facility's VPDES permit and the TMDL.
- The Kilmarnock WWTP was assigned a WLA to address the enterococci impairment for the primary contact use in Indian Creek. However, the WLA was not explicitly stated in the tables of the TMDL report. DEQ will therefore clarify the facility's enterococci WLA by adding it to the WLA tables in the Executive Summary and Chapter 5 of the TMDL report. The incorporation of these tables will allow for the comparison of the WLAs developed for the shellfish use standard and the primary contact use standard.

The modifications requested by DEQ will not change the TMDL or LA values that were originally developed to address the primary contact use impairments in the tidal Indian Creek. A change will only occur to the shellfish use WLA; however, the permittee will discharge at water quality standards, as appropriate. Based upon this information, EPA approves the requested modifications to the Indian Creek TMDL. If you have any questions or comments concerning this letter, please do not hesitate to call me at (215) 814-5796.

Sincerely,

A handwritten signature in blue ink, which appears to read "Helene Drago", is positioned below the "Sincerely," text.

Helene Drago, Manager
TMDL Program



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March 25, 2011

Mr. Greg Voigt
US EPA Region III TMDL Coordinator
USEPA REGION 3 – 3WP12
1650 Arch Street
Philadelphia, PA 19103-2029

RE: Total Maximum Daily Load modifications for waste load allocations in the bacteria TMDL for Indian Creek.

Dear Mr. Voigt,

The purpose of this letter is to request 2 modifications to waste load allocations (WLA) and tables in the bacteria TMDL developed for the tidal Indian Creek impairments. EPA Region III approved the bacteria TMDL addressing primary contact recreational use impairment for Indian Creek on 4/8/2009. The combined modification submittal provides continuity between affected TMDL equations in the original TMDL report.

- **Modification 1:** The waste load allocation (WLA) assigned to Kilmarnock Waste Water Treatment Plant (WWTP)(VA0020788) was incorrectly assigned based on the shellfish use 90th percentile water quality standard of 14 MPN/100ml. Shellfish use WLAs should be based on the geometric mean standard for fecal coliform at 200 MPN/100ml, as this is the limit imposed by DEQ within the facility's VPDES permit. DEQ proposes to revise the facility's shellfish use WLA from 2.68E+08 MPN/day to 3.82E+09 MPN/day to provide consistency between the VPDES permit and the TMDL. This modification to the facility's WLA is not the result of any permit change; rather the original TMDL was based upon the incorrect water quality standard. Various pages throughout the text and tables have been revised. A list of these changes by page number follows in the "TMDL Revisions" section below.
- **Modification 2:** While the Kilmarnock WWTP (VA0020788) was assigned a WLA for the enterococci impairment of the primary contact use on Indian Creek, the WLA is not explicitly stated in a table in the TMDL report. DEQ proposes to clarify the enterococci WLA by adding a table to the Executive Summary and to Chapter 5. The added table is similar to the table used to display the facility's shellfish use WLA in both sections.

The modifications detailed above do not affect the Total Load Allocations or total TMDLs listed in the original tables. Change only occurs to the shellfish use WLA of the facility, and the overall change is less than 1% of the TMDL.

DEQ provided public notice and a 30-day comment period on the TMDL modifications which expired on October 28, 2010. No comments were received. DEQ is submitting this request for modification of the Indian Creek TMDL for EPA approval and have enclosed one printed copy of modified pages for this request.

Permit Details

The Kilmarnock WWTP (VA0020788) priority permit will expire on September 30, 2011.

TMDL Revisions

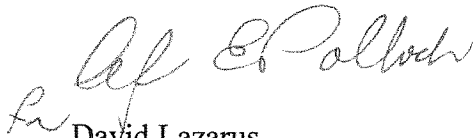
The following tables and text from the Indian Creek TMDL report were affected by the described changes, as follows:

- P v; Table 5.10 added to Table of Contents and Table 5.11 (formerly Table 5.10) corrected
- P xi, Table "Waste Load Allocation Indian Creek - Growing Area 016 Kilmarnock WWTP"; title and table values corrected
- P xi; "Recreation Use Waste Load Allocation Indian Creek – Kilmarnock WWTP" table added to clarify the Kilmarnock WWTP WLA for the recreation use impairment
- P 13, Section "Indian Creek & Tributaries", 1st paragraph; text added to clarify facilities' enterococci WLA and last sentence altered to include additional WLA tables
- P 45; "Table 5.10 Recreation Use Waste Load Allocation Indian Creek – Kilmarnock WWTP" added. Table "Summary for the Recreation Use Impairment on Indian Creek" number changed from 5.10 to 5.11
- P 49, Table 5.15; title and table values corrected
- P 51, Table 5.16A; WLA number corrected for Indian Creek Main Stem
- P 51, Table 5.16B; WLA number corrected for Indian Creek Main Stem

These changes are included in the attached modified Indian Creek TMDL report pages.

In accordance with EPA's August 2003 letter to VADEQ, VADEQ hereby requests EPA approval of the proposed modification. If you or your staff has any questions, please contact me at (804) 698-4299.

Sincerely,



David Lazarus
Watershed Program Manager
Office of Water Quality Programs

Attachments

Replacement page(s)

cc: Charles Lunsford, VADCR
Sandra Mueller, VADEQ
Margaret Smigo, PRO TMDL coordinator
File CO

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Shellfish Use Waste Load Allocation Indian Creek - Growing Area 016 Kilmarnock WWTP

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Fecal Coliform Limit (Geometric mean) (MPN/100ml)	Daily Load (MPN/day)	Future Growth Factor of 1% (MPN/day)	Total Annual Load (MPN/year)	Total Daily WLA for Kilmarnock WWTP (MPN/day)
0.5	1.89E+09	200	3.79E+09	3.79E+07	1.40E+12	3.82E+09

Indian Creek near Kilmarnock Wharf (station 7-IND002.26) was listed as impaired for the primary use (recreational) in VDEQ's 2006 water quality assessment and was re-listed in the 2008 draft assessment report. This report document also includes a primary contact TMDL, shown below. It should be noted the shellfish water quality standard is more stringent than the primary contact standard. Attainment of the shellfish standards will automatically ensure that primary contact standards are being met.

Recreation Use Waste Load Allocation Indian Creek - Kilmarnock WWTP

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Enterococci Limit (Geometric mean) (cfu/100ml)	Daily Load (cfu/day)	Future Growth Factor of 1% (cfu/day)	Total Annual Load (cfu/year)	Total Daily WLA for Kilmarnock WWTP (cfu/day)
0.5	1.89E+09	35	6.62E+08	6.62E+06	2.44E+11	6.69E+08

TMDL Summary for the Recreation Use Impairment in Indian Creek

Impaired Water body Segment	Volume (m ³)	Bacteria Pollutant	Current Load (cfu/day)	Load Allocation (cfu/day)	Wasteload Allocation (cfu/day)	TMDL (cfu/day)	Required Reduction
Indian Creek (C01E-29-BAC) Northumberland County	2128364	<i>Enterococci</i>	1.70E+13	2.21E+12	6.69E+08	2.21E+12	87%

Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. A MOS is either numeric or implicit in the design of the

Indian, Dyrmer, Tabbs and Antipoison Creeks Shellfish TMDL TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

Recommendations for TMDL Implementation

The goal of this TMDL was to develop an allocation plan that achieves water quality standards during the implementation phase. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19.7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters."

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technologies, the installation of best management practices (BMPs) and designation of a No Discharge Zone (NDZ), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The TMDL developed for the Indian, Dyrmer, Tabbs, and Antipoison Creeks watershed impairments provides allocation scenarios that will be a starting point for developing implementation strategies. Additional monitoring aimed at targeting the necessary reductions is critical to implementation development. Once established, continued monitoring will aid in tracking success toward meeting water quality milestones.

Public participation is critical to the implementation process. Reductions in non-point source loading are the crucial factor in addressing the problem. These sources cannot be addressed without public understanding of and support for the implementation process. Stakeholder input will be critical from the onset of the implementation process in order to develop an implementation plan that will be truly effective.

Public Participation

During development of the TMDL for the Indian, Dyrmer, Tabbs, and Antipoison Creeks watersheds, public involvement was encouraged through a public participation process that included public and stakeholder meetings and public comment periods.

The first technical advisory committee and public meetings were held on September 29, 2008. A basic description of the TMDL process and the agencies involved was presented and a discussion was held regarding the source assessment input, bacterial source tracking, and load calculations. Public understanding of and involvement in the TMDL process was encouraged. Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process. The TMDL load allocations were presented during the second public meeting held on November 14, 2008. The public meetings were advertised in the local media, signs advertising the meeting were placed at high access road intersections in the watershed for two weeks before the meetings, and email invitations were sent to local government and stakeholders. There were 9 public comments received during the first public comment period and 7 public comments received during the final public comment period.

Indian Creek & Tributaries

The Kilmarnock Waste Water Treatment Plant (WWTP) (VA0020788) which operates as a minor municipal discharger and is located in the non-tidal portion of an unnamed tributary to Indian Creek off Rt. 608, with two outfalls permitted to the tributary to Indian Creek. Outfall 001 is active and there are no plans to construct outfall 002. Outfall 001 is surrounded by a prohibited zone (a type of shellfish closure area) which was issued by VDH-DSS (shown as section C in VDH condemnations). While outfall 002 has not been built and contributes no fecal coliform bacteria to the stream, it is included in the waste load allocation (WLA) because it was included in the VPDES permit. The Kilmarnock WWTP has a design flow of 0.5 million gallon per day (MGD) and is permitted for total chlorine residual, a surrogate for fecal coliform bacterial limits of geometric mean 200 MPN/100 milliliters. Due to the primary contact recreation impairment of Indian Creek, the facility will also receive a WLA based on the enterococci geometric mean standard of 35 cfu/100mL. If outfall 002 is constructed and begins actively discharging, it is understood that outfall 001 is to be taken offline. Outfalls 001 and 002 should not be in operation simultaneously as the Design Flow of 0.5 MGD is the permitted design in the permit for a single outfall. The WLA assigned in this TMDL report for the Kilmarnock WWTP allows for the operation of one outfall with a maximum design flow of 0.5 MGD. The WLA calculations are available in Tables 5.10, 5.11, 5.15, 5.16A, 5.16B,

The Kilmarnock WWTP reported sewer overflows at the plant for the months of March, May, and November of 2007. This time frame is included within the study period was not during the time when BST samples were being taken. The facility's Discharge Monitoring Report (DMR) did not show any exceedences of their permit for fecal coliform during the sampling time frame.

Dymer Creek

There is one active seafood general permit by Dymer Creek Seafood (VAG524007) which has two outfalls (001, 002) to Georges Cove, a tributary to Dymer Creek. There is one active storm water general permit operated by the Ocran Boat Shop, Inc. (VAR051153) which has one outfall, 001, to Georges Cove.

Tabbs Creek

There are no DEQ permitted dischargers within Tabbs Creek.

Antipoison Creek

There is one active seafood general permit by Pride of Virginia Seafood & Bait Company (VAG524039) which has three outfalls (001, 002, and 003) to Antipoison Creek.

Table 4.1 Permitted Point Sources in Indian, Dymmer, Tabbs, and Antipoison Creeks and Tributaries

Stream Name	Facility Name	VPDES Permit Number	Outfalls	Permit Type	Permitted for Fecal Coliform Control	Design Flow (MGD)
UT to Indian Creek	Kilmarnock Waste Water Treatment Plant	VA0020788	001, 002	Municipal Minor	YES	0.5
Georges Cove (tributary to Dymmer Creek)	Dymmer Creek Seafood	VAG5240007	001, 002	Seafood General	NO	N/A
Georges Cove (tributary to Dymmer Creek)	Ocran Boat Shop	VAR051153	001	Storm Water General	NO	N/A
Antipoison Creek	Pride of Virginia Seafood & Bait Co.	VAG524039	001, 002, 003	Seafood General	NO	N/A

B. Non-Point Source

Non-point sources of fecal coliform do not have one discharge point but may occur over the entire length of the receiving water. Fecal coliform bacteria deposited on the land surface can build up over time. During rain events, surface runoff transports water and sediment to waterways. Sources of fecal coliform bacteria include grazing livestock, concentrated animal feeding operations, manure application, and wildlife and pet excretion. Direct contribution to the waterway occurs when livestock or wildlife defecate into or immediately adjacent to receiving waters. Non-point source contributions from humans generally arise from failing septic systems and associated drain fields, moored or marina vessel discharges, storm water management facilities, pump station failures, and ex-filtration from sewer systems. Contributions from wildlife, both mammalian and avian, are natural conditions and may represent a background level of bacterial loading. It is therefore likely that human loading is due to failures in septic waste treatment systems and/or potential pollution from recreational vessel discharges.

The shoreline survey is used as a tool to identify non-point source contribution problems and locations. Figure 4.33 shows the results of the DSS sanitary shoreline surveys for Indian, Dymmer, and Tabbs dated 2004. The survey identified eleven onsite sewerage deficiencies, 9 boating sources, and 3 animal sources. Four of the onsite sewerage deficiencies and 1 animal deficiency has been corrected or has shown to not be contributive of pollution to the creek. Figure 4.34 shows the results of the DSS sanitary shoreline survey for Antipoison and Davenport Creeks. The survey identified 8 onsite sewerage deficiencies, 5 boating sources, and 1 animal source. Six of the onsite sewerage deficiencies have been corrected or have shown to not be contributive of pollution to the creek. Copies of these surveys are included in Appendix A.

VDH-DSS conducts new Sanitary Surveys every 8 years for each of the growing areas. Corrected violations are updated on a regular basis however new deficiencies are only reported when a new survey has been completed.

Wildlife & Livestock

Livestock numbers in Table 4.2 were gathered through observations made by DEQ TMDL staff by

The load reduction for each standard is calculated utilizing a similar approach as used for the shellfish reductions:

$$\frac{\text{Current Load}_{\max} - \text{Allowable Load}}{\text{Current Load}_{\max}} = \text{Load Reduction}$$

The results for these calculations are shown in Table 5.10.

Table 5.9 Summary of Monitoring Data for Enterococci at Indian Creek (7-IND002.26)

Station ID	Period of Record	Bacteria Constituent	Total Observations	Minimum (cfu/100 mL)	Maximum (cfu/100 mL)	Primary Contact Violation Rate
7-IND002.26	7/2003 to 10/2008	<i>Enterococci</i>	49	10	800	12%

Table 5.10 Recreation Use Waste Load Allocation Indian Creek - Kilmarnock WWTP

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Enterococci Limit (Geometric mean) (cfu/100ml)	Daily Load (cfu/day)	Future Growth Factor of 1% (cfu/day)	Total Annual Load (cfu/year)	Total Daily WLA for Kilmarnock WWTP (cfu/day)
0.5	1.89E+09	35	6.62E+08	6.62E+06	2.44E+11	6.69E+08

Table 5.11 Summary for the Recreation Use Impairment in Indian Creek

Impaired Water body Segment	Volume (m ³)	Bacteria Pollutant	Current Load (cfu/day)	Load Allocation (cfu/day)	Wasteload Allocation (cfu/day)	TMDL (cfu/day)	Margin of Safety	Required Reduction
Indian Creek (C01E-29-BAC)	2128364	<i>Enterococci</i>	1.70E+13	2.21E+12	6.69E+08	2.21E+12	Implicit	87%

5.2 Load Allocation

A comparison of the reductions based on geometric mean load and on the 90th percentile load shows that the 90th percentile load is the critical condition. The 90th percentile criterion is most frequently exceeded. Therefore the 90th percentile loading is used to allocate source contributions and establish load reduction targets among the various contributing sources that will yield the necessary water quality improvements to attain the water quality standard.

The percent loading for each of source category is based on BST source assessment of the watershed and the land use. These percentages are used to determine where load reductions are needed. The loadings for each source are determined by multiplying the total current and allowable loads by the representative percentage. The percent reduction needed to attain the water quality standard or criterion is allocated to each source category. This is shown in Table 5.11A – 5.11E for Indian Creek, Tables 5.12A – 5.12E for Dyrer Creek, Table 5.13 for Tabbs Creek, and Tables 5.14A & 5.14B for Antipoison Creek. These tables are created to fulfill the TMDL requirements by ensuring that the criterion is attained.

Table 5.11A Reductions/Allocations based upon 90th Percentile Standard: Indian Creek Main Stem
(Indian Creek Main Stem includes Pitmans Cove and Arthur Cove)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Indian Creek Main Stem 016-057	Wildlife	23%	4.16E+12	1.04E+12	75%
	Human	65%	1.18E+13	0.00E+00	100%
	Livestock	3%	5.43E+11	0.00E+00	100%
	Pets	9%	1.63E+12	0.00E+00	100%
	Total	100%	1.81E+13	1.04E+12	94%

Table 5.11B Reductions/Allocations based upon 90th Percentile Standard: Barnes Creek
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Barnes Creek 016-057	Wildlife	23%	1.36E+11	1.36E+11	0%
	Human	65%	3.85E+11	1.58E+11	59%
	Livestock	3%	1.78E+10	1.78E+10	0%
	Pets	9%	5.33E+10	5.33E+10	0%
	Total	100%	5.92E+11	3.65E+11	38%

Table 5.11C Reductions/Allocations based upon 90th Percentile Standard: Henrys Creek
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Henrys Creek 016-057	Wildlife	23%	7.18E+10	7.18E+10	0%
	Human	65%	2.03E+11	1.04E+11	49%
	Livestock	3%	9.36E+09	9.36E+09	0%
	Pets	9%	2.81E+10	2.81E+10	0%
	Total	100%	3.12E+11	2.13E+11	32%

Table 5.11D Reductions/Allocations based upon 90th Percentile Standard: Bells Creek
(tributary of Indian Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Bells Creek 016-057	Wildlife	23%	4.02E+10	4.02E+10	0%
	Human	65%	1.14E+11	6.38E+10	44%
	Livestock	3%	5.25E+09	5.25E+09	0%
	Pets	9%	1.58E+10	1.58E+10	0%
	Total	100%	1.75E+11	1.25E+11	28%

Table 5.14B Reductions/Allocations based upon 90th Percentile Standard: Davenport Creek
(tributary to Fleets Bay north of Antipoison Creek)

Condemnation Area	Fecal Type	BST Allocation % of Total Load	Current Load MPN / day	Load Allocation MPN / day	Reduction Needed
Davenport Creek 017-188	Wildlife	30%	2.39E+10	1.38E+10	42%
	Human	66%	5.27E+10	0.00E+00	100%
	Livestock	2%	1.60E+09	0.00E+00	100%
	Pets	2%	1.60E+09	0.00E+00	100%
	Total	100%	7.98E+10	1.38E+10	83%

The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process. Human derived fecal coliforms are a serious concern in the estuarine environment and discharge of human waste is precluded by state and federal law. According to the preceding analysis, small (Bells Creek and Ashley Cove) to large reductions (Indian Creek, Dymmer and Tabbs Main Stems) of the controllable loads (e.g. human, livestock, or pets) are necessary to achieve the water quality standard for the condemnation areas. However, due to the episodic listing and delisting patterns related to this condemnation, and to meet the intent of the Clean Water Act, any human loads present should be eliminated from the system. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that no further reductions are necessary or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis (UAA) for the waterbody (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDLs could be implemented to achieve water quality standards; however, the state reserves the right to allocate differently, as long as consistency with the achievement of water quality standards is maintained.

A. Development of Wasteload Allocations

There is one permitted discharge for fecal coliform in the watershed, the Kilmarnock Wastewater Treatment Plant. Based on the maximum daily design flow of 0.5 MGD, A WLA of 2.68E+08 is assigned for this facility as noted in Table 5.15 below. The WLA is for the operating outfall which is currently outfall 001. If outfall 002 is ever constructed, the single WLA of 2.68E+08 will be applicable for that outfall as well. Only one outfall is to be in operation at a time.

Table 5.15 Shellfish Use Waste Load Allocation - Kilmarnock WWTP (The receiving stream is an upper non-tidal tributary to the Indian Creek main stem condemnation.)

Design Flow (MGD) Outfall 001 or 002	Design Flow (mL/D)	Fecal Coliform Limit (Geomean) (MPN/100ml)	Daily Load (MPN/day)	Future Growth Factor of 1% (MPN/day)	Total Annual Load (MPN/year)	Total Daily WLA for Kilmarnock WWTP (MPN/day)
0.5	1.89E+09	200	3.79E+09	3.79E+07	1.40E+12	3.82E+09

5.3 Consideration of Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. The current loading to the waterbody was determined using a long-term record of water quality monitoring (observation) data. The period of record for the data was 1984 to 2008. The resulting estimate is quite robust.

A comparison of the geometric mean values and the 90th percentile values against the water quality criteria will determine which represents the more critical condition or higher percent reduction. If the geometric mean values dictate the higher reduction, this suggests that, on average, water sample counts are consistently high with limited variation around the mean. If the 90th percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions. For this study, the 90th percentile criterion is the most critical condition. Thus, the final load reductions determined using the 90th percentile represents the most stringent conditions and it is the reductions based on these bacterial loadings that will yield attainment of the water quality standard. Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. Variations due to changes in the hydrologic cycle as well as temporal variability in fecal coliform sources, such as migrating duck and goose populations are accounted for by the use of the long-term data record to estimate the current load.

5.4 Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection. A MOS is either numeric or implicit in the design of the TMDL. In this TMDL the MOS is implicit in the conservative assumptions used in the load calculations, such as using the worst case bacterial concentrations in current load calculations, resulting in the highest and most protective percent reductions.

5.5 TMDL Summary

To meet the water quality standards for both geometric mean and 90th percentile criteria, the TMDL for each of the four Creeks must be defined for both the geometric mean load and the 90th percentile load, as required by USEPA. A future growth factor of 1% of the total TMDL was included as a Waste Load Allocation to cover future construction of waste treatment facilities. The TMDLs for each creek are summarized in the Tables 5.16A through 5.19B.

Table 5.16A TMDL Summary for Closures in the Indian Creek Watershed (geometric mean)

(Indian Creek Main Stem includes Pittmans, Waverly, and Arthur Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN/day (Future Growth)	Load Allocation MPN / Day	Margin of Safety
Indian Creek Main Stem	Fecal Coliform	2.96E+11	3.82E+09	2.93E+11	Implicit
Barnes Creek	Fecal Coliform	1.04E+11	1.04E+09	1.03E+11	
Henry's Creek	Fecal Coliform	6.09E+10	6.09E+08	6.03E+10	
Bells Creek	Fecal Coliform	3.57E+10	3.57E+08	3.53E+10	
Long Creek	Fecal Coliform	6.89E+09	6.89E+07	6.82E+09	

Table 5.16B TMDL Summary for Closures in the Indian Creek Watershed (90th percentile)

(Indian Creek Main Stem includes Pittmans, Waverly, and Arthur Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Indian Creek Main Stem	Fecal Coliform	1.04E+12	3.82E+09	1.04E+12	Implicit
Barnes Creek	Fecal Coliform	3.65E+11	3.65E+09	3.61E+11	
Henry's Creek	Fecal Coliform	2.13E+11	2.13E+09	2.11E+11	
Bells Creek	Fecal Coliform	1.25E+11	1.25E+09	1.24E+11	
Long Creek	Fecal Coliform	3.17E+10	3.17E+08	3.14E+10	

Table 5.17A TMDL Summary Closures in the Dymer Creek Watershed (geometric mean)
(Dymer Creek Main Stem includes Johnson Creek and Chases Cove)

Condemnation Area	Pollutant Identified	TMDL MPN / day	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Dymer Creek Main Stem	Fecal Coliform	2.36E+11	2.36E+09	2.34E+11	Implicit
Ashley Cove	Fecal Coliform	3.35E+10	3.35E+08	3.32E+10	
Georges Cove	Fecal Coliform	2.00E+10	2.00E+08	1.98E+10	
Hunts Cove	Fecal Coliform	3.00E+10	3.00E+08	2.97E+10	
Lees Cove	Fecal Coliform	7.16E+09	7.16E+07	7.09E+09	

Table 5.17B TMDL Summary Closures in the Dymer Creek Watershed (90th percentile)
(Dymer Creek Main Stem includes Johnson Creek and Chases Cove)

Condemnation Area	Pollutant Identified	TMDL (MPN / day)	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	Margin of Safety
Dymer Creek Main Stem	Fecal Coliform	8.25E+11	8.25E+09	8.17E+11	Implicit
Ashley Cove	Fecal Coliform	1.17E+11	1.17E+09	1.16E+11	
Georges Cove	Fecal Coliform	7.01E+10	7.01E+08	6.94E+10	
Hunts Cove	Fecal Coliform	1.05E+11	1.05E+09	1.04E+11	
Lees Cove	Fecal Coliform	2.51E+10	2.51E+08	2.48E+10	

Table 5.18A TMDL Summary Closures in the Tabbs Creek Watershed (geometric mean)

Condemnation Area	Pollutant Identified	TMDL (MPN / day)	Waste Load Allocation MPN / day (Future Growth)	Load Allocation MPN / day	MOS
Tabbs Creek	Fecal Coliform	1.53E+11	1.53E+09	1.51E+11	Implicit